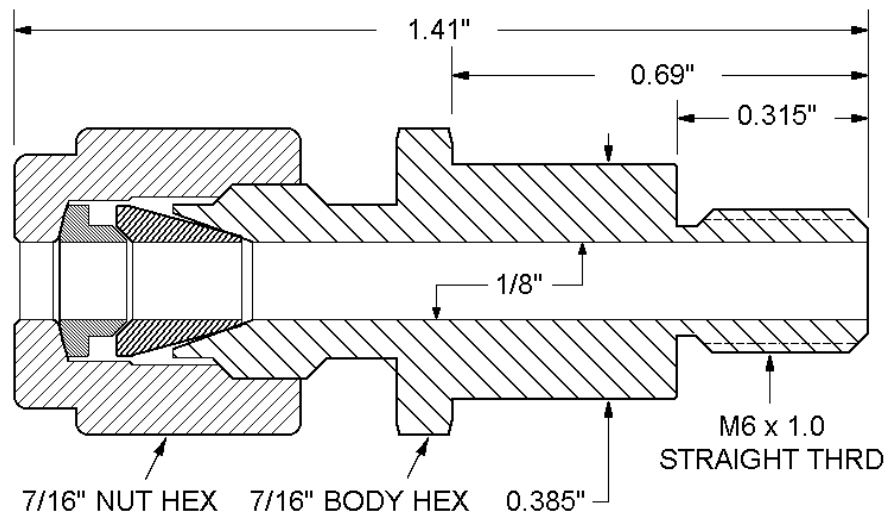


Digital Thermometer & Adaptor for E-61 Groupheads

May 1, 2009

Introduction:

The purpose of this adaptor and digital thermometer is to facilitate the measurement of brew water temperature about 1.25" away from the puck during a brew cycle. In addition, and **EQUALLY IMPORTANT**, it measures the temperature of the grouphead at the indicated location under idle conditions. It requires no drilling, tapping, soldering, brazing, cutting, teflon tape, or epoxy but is **ONLY** capable of fitment to E61 groupheads that are fully exposed. **The difference between the temperature that you will be measuring using this adaptor and the measured temperature of water hitting the puck is approximately 3-5 degrees F** but may vary with different machines and different brew conditions and most certainly, varies over the course of a typical 23-27 second shot.

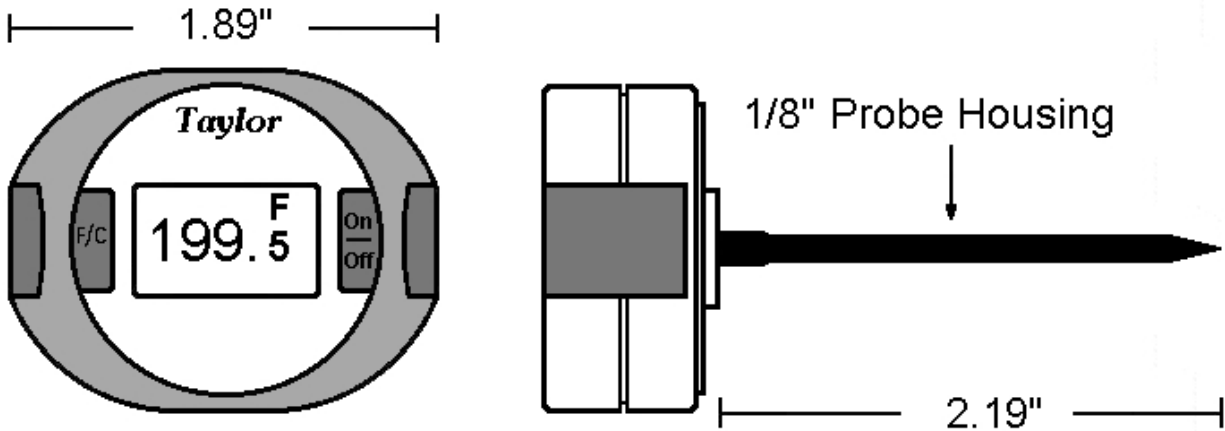


Digital Thermometer Adaptor - Exposed E-61 Grouphead

Indicated temperatures will be higher than those presented to the puck when using the flush-n-wait technique whereas indicated temperatures will be lower than those presented to the puck when using the flush-n-go technique - <http://www.home-barista.com/forums/need-hints-on-using-e61-thermocouple-adaptor-t5125.html>

There have been several successful adventures in measuring brew water temperature in espresso machines. The best example would be the Scace Thermofilter. It is a well-engineered device, designed to measure brew temperature during an accurately simulated double-shot brewing process. Instructions for the use of this device and a professional review of it can be found here:

<http://www.home-barista.com/forums/viewtopic.php?t=453>



Background:

This adaptor is identical to the original thermocouple adaptor except that the “bored-through” size of the fitting is 1/8” (0.125”) vice the original adaptor which has a bored-through size of 1/16” (0.0625”) and the overall length is increased by about 3/16”. In addition, the width of the 7/16” hex on the main body is shortened to enable installation in all machines without adding any additional copper washers as spacers. The advantage to this device is that it is a complete solution to the task of measuring temperature whereas the original thermocouple adaptor requires a thermocouple and appropriate meter. The disadvantage of this device when compared to the original thermocouple adaptor is in accuracy, response time, and temperature readout resolution (depending on the meter used with the original thermocouple adaptor).

My preference, of course, is the original thermocouple adaptor but sometimes the SO’s in our lives do not necessarily want the kitchen turned into an espresso laboratory and, sometimes, we do not want it either.

Kit Contents:

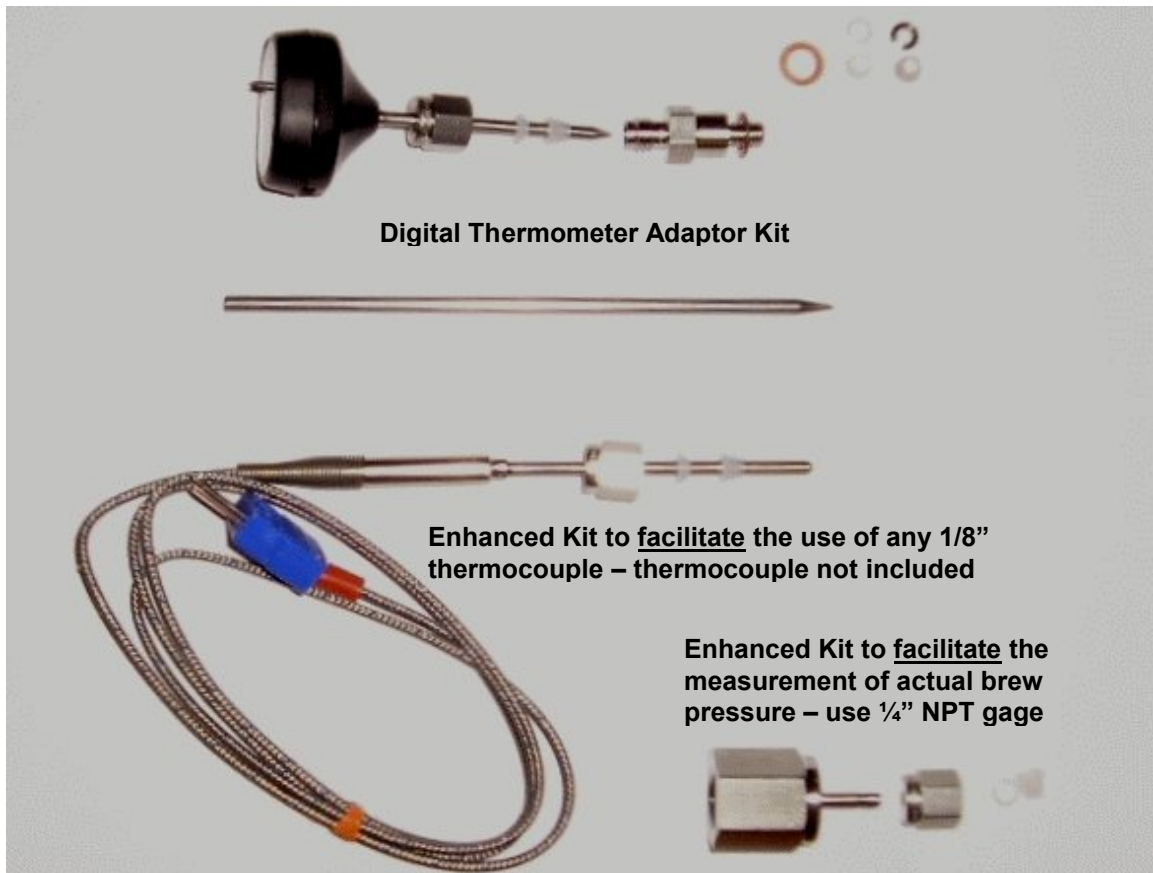
- a. Stainless steel adaptor fitted with replaceable nylon ferrules and a modified Taylor Model 524 digital thermometer. Display is user selectable between °F or °C
- b. Two 6 mm copper sealing washers (one for installation, one as spare)
- c. Adaptor closure plug (should you want to temporarily remove the thermometer **ONLY**)
- d. One set of spare nylon ferrules (front and back) for adaptor
- e. Probe Housing from the original thermometer with small rubber cap for use with the Weiss Distribution Technique – only shipped with units **sold direct**

Enhanced Kits:

The primary purpose of the adaptor is to allow the use of the modified digital thermometer to assist in making your espresso better and more consistent. However, once the adaptor is installed, there are very inexpensive options available that would greatly enhance the utility of the adaptor. These enhanced kits are priced separately as shown in the Pricing_Inventory_Ordering pdf document, which is available here:

<http://users.rcn.com/erics/>

The pressure gage adaptor can be used with ANY pressure gage having a 1/4"-18 male NPT connection but it would be highly advisable that the gage be "liquid filled" so as to dramatically dampen gage needle vibrations. This is especially important if your machine is fitted with a vibration pump. It will indicate the pressure presented to the coffee during an actual brew cycle or the preinfusion pressure when the machine is equipped with a rotary pump that is directly connected to the supply main. A nice gage would be this one: <http://www.gaugestore.com/prodinfo.asp?number=38305> .



Checking the Accuracy of the Thermometer:

This is **NOT** something you would **NORMALLY** do, but it does prescribe the procedure I utilize.

The digital thermometer included in each kit is not capable of being calibrated but it is easy to check its accuracy and speed of response by suspending the tip into the steam portion of a covered pot of boiling water or a thermos jug/jug cap filled with a distilled water / ice slurry mixture.

Note your current altitude, e.g., Silver Spring, Maryland is about 300 feet above sea level; Denver, Colorado is slightly more (grin).

Note your current barometric pressure e.g. 29.92" Hg, 28.96" Hg, 29.54" Hg, etc. You can use this website to determine water's boiling point:

<http://www.csgnetwork.com/h2oboilcalc.html>

For example, the current barometric pressure in Silver Spring, MD is 30.32" Hg, referenced to sea level. If I were at sea level, the boiling point of water would be 212.66 degrees F. However, because Silver Spring, Maryland averages about 300 feet



above sea level, the boiling point of water at the current barometric pressure is 212.14 degrees F. Suspend the probe end of the digital thermometer into a pot of vigorously boiling water and observe the meter reading with the probe **suspended in the steam.**

Punch a 1/8" hole into a 2" x 2" piece of cardboard to avoid steaming up the underside of the thermometer. A simple teakettle would also be fine for this purpose. Make both a mental and physical note of the reading. Recheck, as you feel necessary.

Another method of "checking" YOUR digital thermometer kit is to immerse the thermometer tip in a covered short thermos jug filled with a mixture of crushed, distilled water ice and distilled water – think of a flavorless coarse slurpy. This method is nice because it is independent of altitude and barometric pressure but needs about 15 minutes or so to stabilize around the established freezing point of water (32.0 F).

Each digital thermometer **sold direct** ships with a tag attached to the probe stem. The small writing at the bottom shows the temperature of boiling water/condensing steam here in Silver Spring, Maryland (MD) for the particular test day conditions, the date of the test, and my initials. The large number shows what the thermometer read while in the "test pot." The writing will not be as neat as that shown below.

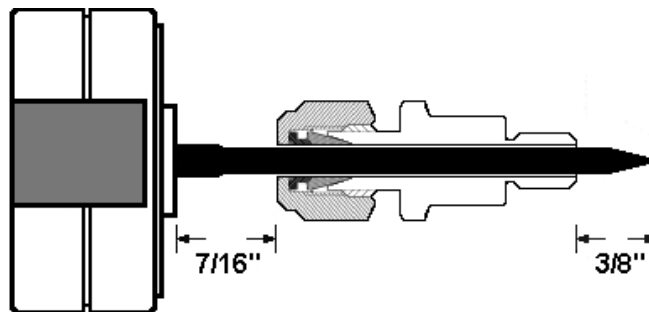


Kits shipped with the Taylor 524 thermometer typically have one side in degrees Fahrenheit and the other in degrees Celsius. Celsius thermometers are independently tested reading both temperature scales, i.e. the numbers MAY NOT equate mathematically in accordance with the established conversion formulas from F to C or C to F.

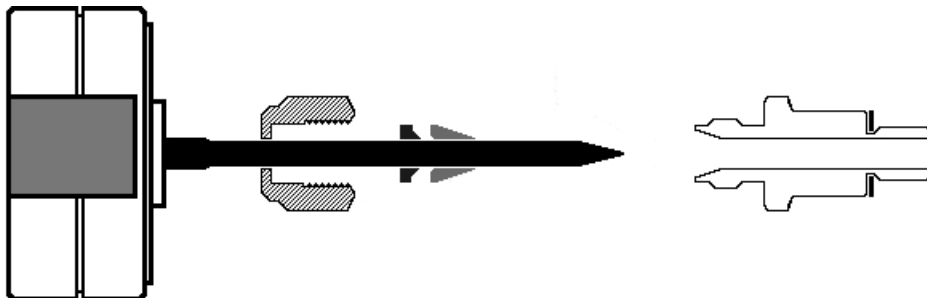
Installing the Digital Thermometer and Adaptor:

The digital thermometer adaptor is packaged with a flexible plastic cap protecting the M6 threads and holding the copper washer in place for shipping. The cap has dimensions such that the probe is **APPROXIMATELY** in the correct position for installation **but the nut will only be finger-tight**. The recommended depth of the probe is achieved by having the probe tip protrude $\frac{3}{8}$ " beyond the end of the M6 threading on the adaptor. This depth should be very satisfactory for the majority of all machines with very few exceptions. It is best to install the adaptor and thermometer in the machine at room temperature as you will be working in the grouphead area where it is very easy to get burned.

Remove the existing M6 x 8 mm allen-head capscrew using a 5 mm long-handle allen wrench. The existing copper or teflon sealing washer will likely come off semi-attached to the capscrew. If not, remove it from the machined recess in the grouphead and set aside as an emergency spare. Clean the recess and the seating surface for the new copper washer with a water-moistened Q-tip as necessary - a few swipes should do it. Remove the protective plastic cap from the M6 threads and check the protrusion of the probe from the end of the M6 threading. It does not have to be exact, i.e. $\pm \frac{1}{32}$ " from the required dimension of $\frac{3}{8}$ " is fine. Adjust as necessary, tightening the $\frac{7}{16}$ " nut only finger tight. Note the distance between the bottom of the thermometer and the top of the $\frac{7}{16}$ " nut. It should be approximately $\frac{7}{16}$ " as shown in the illustration below.

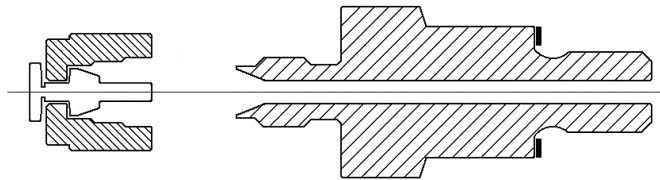


After you have satisfied yourself that the dimensions are correct, unscrew the $\frac{7}{16}$ " nut, slide the thermometer, nut, and pair of ferrules out of the adaptor and set aside. The small back ferrule sometimes remains trapped within the nut – this is fine.



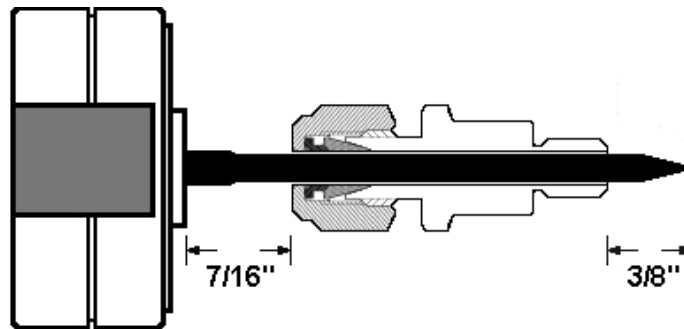
Removing the Digital Thermometer – Adaptor Remains in Machine:

Loosen the 7/16" thermometer nut completely and remove the thermometer, nut, and ferrules as a unit. In order to operate the machine, it will be necessary to install the closure plug supplied with the kit. Proceed as follows:



Installing Plug Onto Adaptor Body

Install the adaptor closure plug onto the adaptor fitting **finger-tight**. Note that the adaptor closure plug seals **without the use of any ferrules**. Using a short 7/16" combination wrench, tighten the plug only **1/8 turn (45 degrees) past finger tight** while applying a counter-hold on the 7/16" hex on the adaptor body. Plug the machine in, turn it on, and let it reach normal brewing temperature. Pull a shot through an empty basket and look for any leakage in the area of the adaptor fitting. Now put a blind basket in the portafilter and backflush the machine by cycling the pump on for 10 seconds and off for 10 seconds. There should be no leakage from the area where the plug attaches to the adaptor fitting. If necessary, tighten the plug **just enough** to stop any leaks while applying a counter-hold to the adaptor body hex.



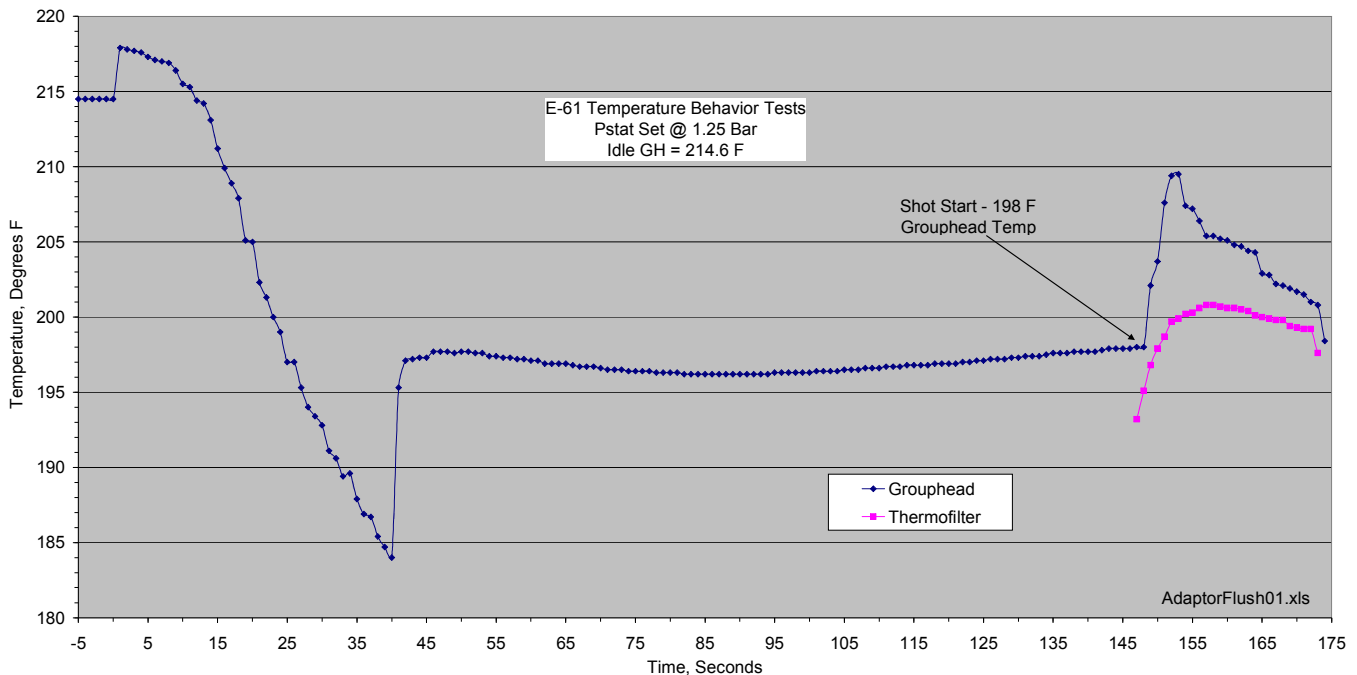
Reinstallation of the Digital Thermometer:

While it is certainly best to use new ferrules when reinstalling the thermometer, old ferrules can be reused but the 7/16" thermometer nut is simply snugged up past finger-tight and **NOT** tightened as per the instructions for new ferrules. The nut goes on first, then the back ferrule (**NOTE THE ORIENTATION**), and finally the front ferrule.

Install the thermometer such that the distance between the top of the 7/16" nut and the bottom of the plastic thermometer housing is approximately 7/16" – use a cut piece of cardboard to attain this dimension. Turn the nut finger tight and then tighten it **3/4 of a turn** (new ferrules only) or simply snug the nut up when reusing the old ferrules.

Operation of the Espresso Machine with the Digital Thermometer:

An E-61 espresso machine having a heat exchanger (hx) can be operated in numerous ways. I will attempt to explain two methods that certainly achieve the same results but differ by 180 degrees (**NOT** temperature degrees) in their methodology. The first method I have termed “flush-n-wait”, the second method is termed “flush-n-go”, a term I believe was originated by Dan Kehn, webmaster at home-barista.com. In the flush-n-wait method, you are flushing a sufficient quantity of water through the grouphead to cool it down a few degrees **BELOW** desired brew temperature. Using the flush-n-go method, you are flushing a sufficient quantity of water through the heat exchanger to cool its volume of water well **BELOW** desired brew temperature but the grouphead will remain **ABOVE** desired brew temperature. The “wait” method requires an additional 3 ounces of flushing water than the “go” method but the actual quantities and the approximate differential will depend greatly on the pressurestat (pstat) setting and the design characteristics of your particular machine.

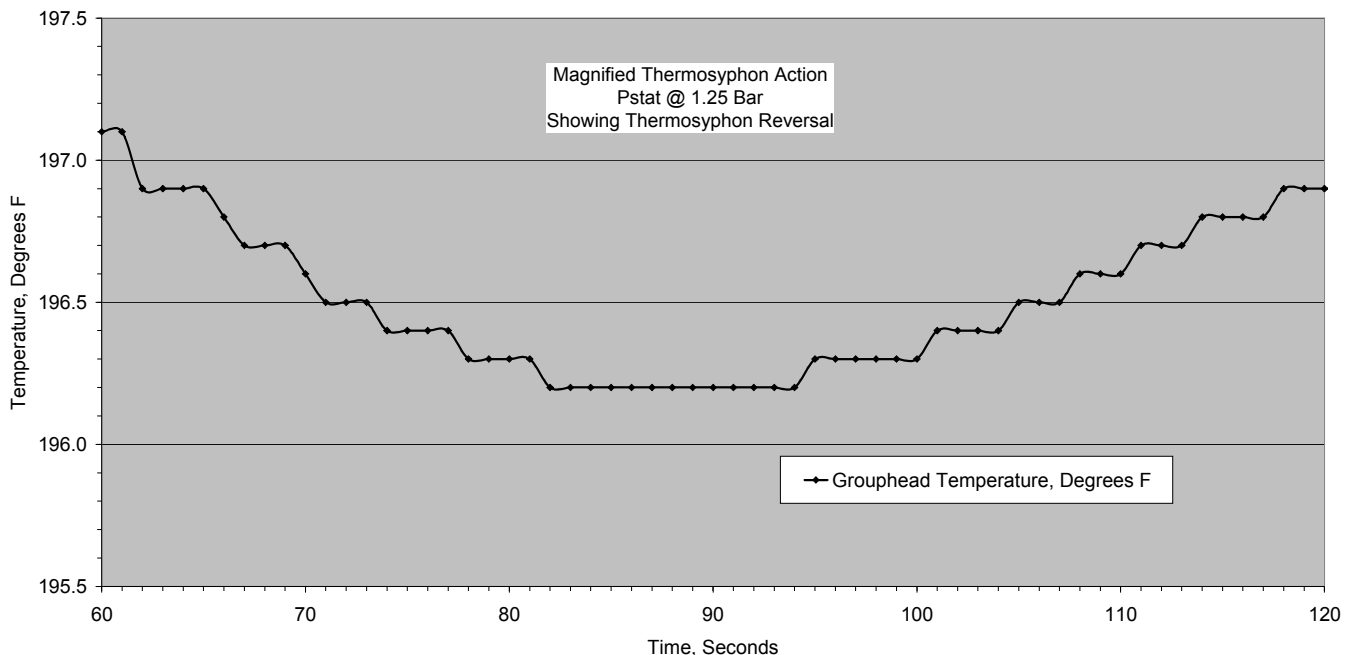


See this link for some graphical representations of the different methods - <http://www.home-barista.com/tips/need-hints-on-using-e61-thermocouple-adapter-t5125.html> . Everybody has a different pressurestat (pstat) setting – sometimes whether you like it or not. It is not unusual for gages to be off by around 8% and just the variation in altitude between two users can result in a boiler absolute pressure difference of 0.2 bar. I currently have my pressurestat set to a maximum reading of 1.20 bar (light probably goes out at ~1.15 bar) as this appears to provide a reasonable balance between the amount of flushing, the machine recovery after a shot, and steaming power.

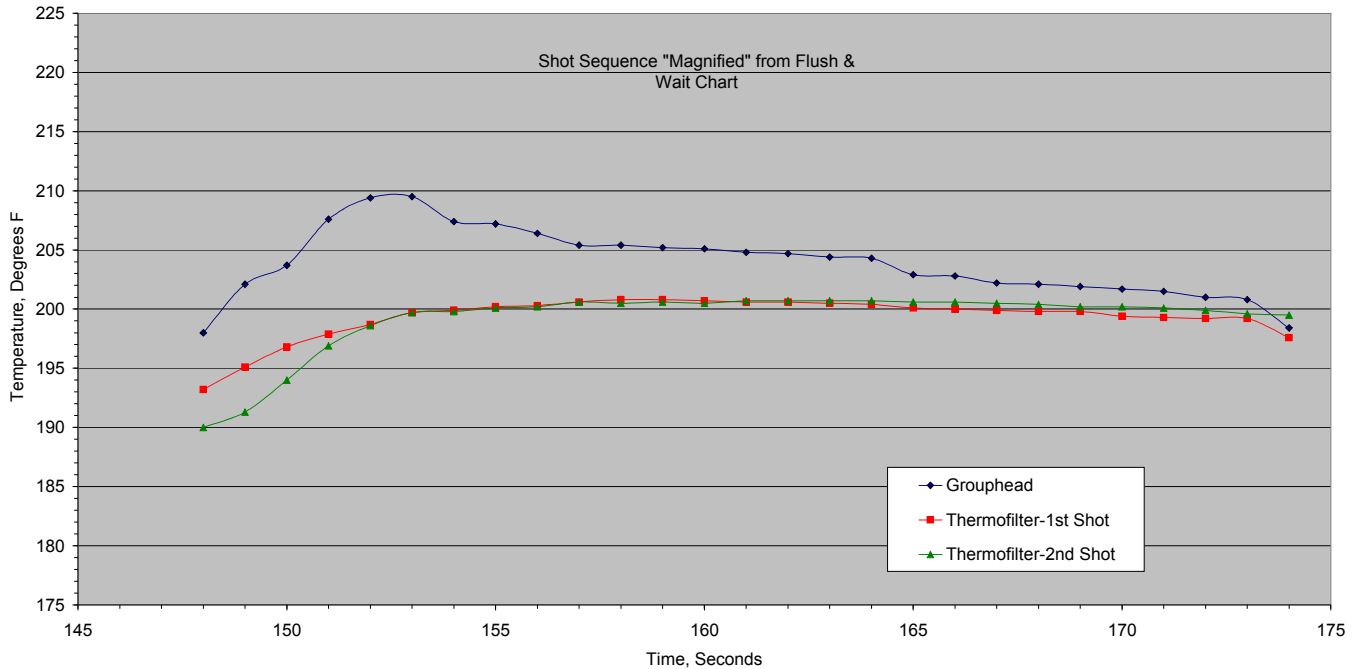
- a. Ensure that the machine has been idle for at least 30 minutes or if starting from a cold machine, 60 minutes.
- b. Flush the machine until the thermometer reads 185 F +/- 1 degree. A higher pstat setting such as 1.15 to 1.20 bar would benefit from a flush to 184 F whereas a lower pstat setting, such as 1.05 to 1.10 bar would mate well with a flush to 186 F.

Note that the modified Taylor 524 thermometer is equipped with a small green LED that will light up at ~ 205 F (96.1 C). This has no significance. The chart on the previous page is from an Anita that has a vibratory pump and the temperatures are being measured with a thermocouple. If your machine is equipped with a rotary pump, the time to attain 185 F on your display will surely be less as your flushing flow rate is slightly more than that of the vibratory pump and your source water temperature is lower. As you are pumping away here, the digital thermometer in the adaptor is reading the temperature of the water flowing past. Very soon after you stop pumping (flushing), the thermometer starts reading **A TEMPERATURE** that is fairly representative of grouphead temperature. As seen in the chart, it almost instantaneously bounces up to about 197 F.

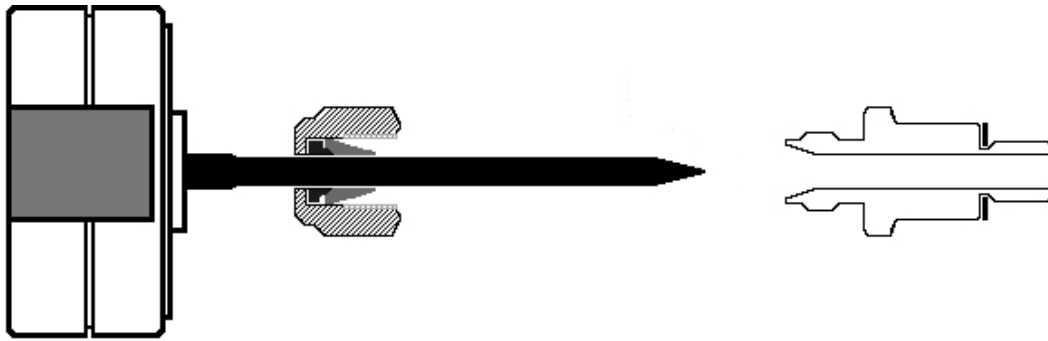
However, since the water in the heat exchanger is now about 100 degrees or so below where it was when you started the flush, a **REVERSE THERMOSYPHON ACTION** is started and heat is being drawn **OUT** of the grouphead. The grouphead temperature starts to head **DOWN**. Below I have a graph that is a magnified version of the 70 to 110 second interval – the scale is changed to magnify the dip. At about the 83-second point, thermosyphon action reverts to **NORMAL** and the grouphead temperature starts to climb upwards. If you did **NOTHING** for the next 20 minutes or so, the grouphead temperature would be right back wherever you started – in my case 214.6 F.



- c. Now, there is an awful lot more to a “perfect shot” than just “good” temperature management but I am simply illustrating how the digital thermometer adaptor (or thermocouple adaptor) can help.
- d. Nothing in the foregoing should necessarily cause you to make changes to your machine as each machine is different although certainly the temperature **RESPONSE TIMES** of the Quickmill Anita, Andreja, and Vetrano would be very similar. However, all three would be different than, say, a Fiorenzato Bricoletta or Vibiemme Domobar.
- e. If you perform this little test a couple of times each day for a couple of days, you can get a pretty good idea of how your machine operates, i.e., how long it takes for the grouphead to recover from what seems like over flushing.
- f. A good idea would be to flush into the cup you plan on using for the coffee – most definitely this will heat the cup up. Be sure to wipe it dry prior to pulling the shot into it.



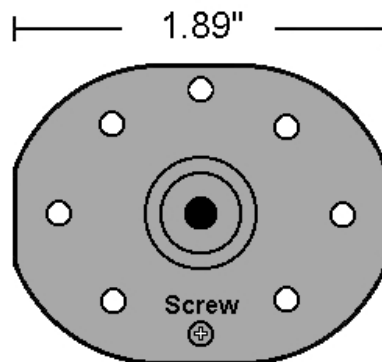
- g. When the group hits 197 F +/- 1 (on the way up), start the shot and you **SHOULD** average very close to 200 F +/- 1 brew temperature with a 1.0 degree variance during the typical 23-27 second shot.



Digital Thermometer Maintenance – Battery Replacement:

The battery installed in the Taylor 524 is a lithium cell CR2032 battery and is a very common “button-cell” battery available in many stores. The battery should be replaced when readings grow dim or irregular. You will need a small Philips head screwdriver as is typically found in a “jeweler’s” screwdriver set or a # 0 Philips head screwdriver.

Fully loosen the 7/16” nut at the top of the adaptor body and remove the thermometer, nut, and ferrules from the adaptor body as a unit.



Gently pull off the silicone backing under the base of the thermometer head.

Loosen the small screw located inside the hole in the base part of the thermometer using a No. 0 Philips head screwdriver or a small jeweler’s screwdriver.

Separate the base/stem from the thermometer head using a small coin or similar device in the slot provided.

Remove the screw that secures the battery cover and remove the battery cover. Replace the battery with a new CR2032 having the “+” sign facing you. Replace the battery cover and battery cover screw.

Note the circular wire routing in the base and **ENSURE** that the wiring and hot-melt glue where the wiring enters the probe remain **INTACT**. Gently push the thermometer head and base back together until the pieces click securely in place. Replace the screw in

the hole under the base of the thermometer and replace the silicone backing.

Reinstall the thermometer in the adaptor, maintaining a distance of 7/16” between the thermometer and the top of the 7/16” adaptor nut. It is NOT necessary to replace the ferrules.

Tighten the nut with your fingers and then simply snug it up with a wrench (this should be less than ¾ turn) because you are now “swaging” used ferrules.

Digital Thermometer Specifications:

Range: -16 to 302 F or –9 to 150 C

Resolution: 0.1 F or 0.1 C over full range

Battery: CR2032 lithium (installed)

Auto Shut-Off: After 30 seconds if no change in temperature is detected

Response Time: 1 second

Operation: The buttons for On/Off and degrees F/C are soft touch. This thermometer, designated by the manufacturer as a ‘baking’ thermometer, has a green LED that will light up AROUND 205 F. There is no intentional significance to this for operation.

Spare Parts:

Nylon ferrule set	Swagelok P/N NY-200-SET
6 mm copper washer	Copper sealing washer, 6.2 x 9.9 mm
7/16” Nut	Swagelok P/N SS-202-1
Plug	Swagelok P/N SS-200-P
Battery	CR 2032

Pricing and Stock Status:

Complete ordering information and stock status can be found in the document entitled Pricing_Inventory_Ordering available for download on my crude FTP site: <http://users.rcn.com/erics/> . Comments on these instructions or questions of a general nature that could be included in the FAQ section of the install manual would be GREATLY appreciated. The latest updates to this document, **in addition to other goodies of information**, are always available at <http://users.rcn.com/erics/> .

You should always check for this prior to your installation AND you should, hopefully, not misplace these instructions.

Eric Svendson 1223 Woodside Pkwy Silver Spring, MD 20910-1666
Phone 301-587-5033 E-mail - erics@erols.com

Warranty:

For the first 30 days – full refund of monies exclusive of postage and CoffeeKids donation will be made upon your request **AND** upon receipt of product.

The thermometer, attached probe, and any purchased accessories are guaranteed to be fully functional for 1 year from the date of purchase. The stainless steel and brass adaptors, excluding the ferrules and copper washers, are warranted to the original purchaser for life. Replacements during this time period will be made for the cost of postage, shipping supplies, and a small “handling” fee - \$10.00 **AND** upon receipt of old unit. Replacement units will ship with one set of new ferrules and nut. You are obligated to return the old parts (nut and ferrules and thermometer)

If the thermometer was purchased directly from me, no receipt is required – I retain **ALL** e-mails. If the thermometer was purchased from Chris’ Coffee, an order number or some other validated document showing the purchase date is required.

Frequently Asked Questions (in a very random sequence)

1. How “custom” is this adaptor? Can I get spare parts readily?

The particular adaptor currently has a 6 to 8 week lead-time – is this custom enough for you? All of the parts, which make up the adaptor with the exception of the body, are “off the shelf” parts, typically stocked by Swagelok distributors. Even if the part(s) is not stocked, it would be available in a couple of days – they are all standard catalog items. I always have all the spare parts available that you could ever want.

2. Is it OK to take the adaptor apart when I get it?

You certainly can but be sure to take it apart on a soft, dark surface with a “mandrel” of sorts slid inside. This is to minimize the chances of dropping small, almost translucent, parts (which you would be hard pressed to find) all over the floor. The ideal mandrel is any smooth 1/8” diameter “rod”, e.g., a 1/8” drill bit, 1/8” tubing, possibly a smooth 1/8” wooden dowel, or the thermometer probe itself.

3. What temperatures should I shoot for?

For sure that depends on the beans you are using but I have found that a measured average temperature of 203 F at the passageway intersection (with Silvia) corresponds to 198 F water hitting the “puck”.

4. Should I use the plug that came with the kit?

The plug allows you to remove the thermometer for in or out of warranty service/repair and operate your machine in a normal manner. Install the adaptor and plug as per the instructions and become intimate with your machine. Practice making consistent shots (not necessarily great shots) in the SAME identical manner to which you have become accustomed.

5. Why can I still turn the 7/16 nut after I have tightened it the prescribed 3/4 of a turn from finger tight?

Nylon has a little more “give” than metal. Turning the nut over 3/4 turn will distort the nylon ferrules such that their reusability is questionable. Tightening the nut as described in the instructions should be sufficient.

6. I have removed my M6 allen head screw like you said and there is NO copper washer present.

Hmm. Hmm. Every penny counts in manufacturing and sometimes these people go too far. The screw was probably sealed with sealant on the threads. OBVIOUSLY, it

worked with your espresso machine and IT WORKS in many other applications because the sealant is applied in very controlled conditions but, IMO, it is not the best way; certainly not for a retrofit. Use a new copper washer on the thermocouple adaptor, follow the instructions EXACTLY as written and you will be happy with a leak-proof connection.

7. Are there any special instructions for E61 heat exchanger machines? Yes, please read the document entitled “thermocouple adaptor tidbits” available from my FTP website: <http://users.rcn.com/erics/> . In addition, there exists an abundant supply of well-written and informative articles on hx machine operation, particularly on this website - <http://www.home-barista.com/> . However, someone who makes strictly espresso with a heat exchanger (hx) machine has an advantage over one who is using the same type of machine but also making cappy’s and latte’s. The rational being that the pstat setting can be slightly lowered which will inherently lower boiler water temperature and thus hx temperature. In turn, this will reduce the cooling flush requirements.

8. Can I re-use any of those copper washers you supply?

Well, you can, but it is not the best practice. The copper sealing washers actually compress during installation and thus conform to any irregularities on the surfaces. When tightening the adaptor with a used copper washer, simply “snug it up” as it would require too much torque to deform it as in an original install. Spare washers are best obtained from the parts department of a German car dealership.

9. How about updates to this installation manual?

The latest updates are always available at <http://users.rcn.com/erics/> . You should always check for this prior to your installation. Click on the “Digital Thermometer Adaptor” folder and then open/save the appropriate pdf file contained therein.

10. How do I go about ordering and paying for one of these devices?

Please see the document Pricing_Inventory_Ordering.doc available here: <http://users.rcn.com/erics/> for more detailed pricing information.

I do accept Paypal (my Paypal email is same as normal email) however please note that Paypal charges me a fee for transactions so add this additional amount onto your total and I will forward a check to CoffeeKids on your behalf and provide an appropriate email to you as a receipt.

11. Does this gizmo have any “problem areas” that I should know about?

Well, ahem, I’m glad you asked. The switch or switches (in the case of the 3516 & 9841) are simply miniature sliding contacts that CAN BE tough to operate. While it is

rare, sometimes they don't make the best contact – in this case press down on the button and/or turn the device on/off a few times. Operation of the switch will improve with use.

12. What can you say about the quality of the thermometer and/or thermistor?

Well, ahem, ahem, I'm glad you asked this also. We have all seen the dozens of digital thermometers available in stores and on the internet. Heck, just do a "google search" on [digital thermometer] and sit back awhile. As received by me, these thermometers are put together in a manner commensurate with their cost. HOWEVER, taking them apart, cleaning out the globs of excess hot melt glue, applying the heat shrink tubing to the thermistor leads, and dabbing the thermistor in heat transfer grease makes them very nice indeed. The thermometers utilize a 50K ohm NTC (negative temperature coefficient) thermistor of surprisingly high quality and that has an industry standard temperature-resistance curve. The Taylor 524 thermometers utilize a 100K ohm NTC thermistor. In short, I take an "OK" product and make it darn good.

13. Would you answer any questions over the phone that I might have?

Sure – call anytime up until midnight (EST) 7 days a week – 301-587-5033.

14. Do I need any special tools to install this device?

The ONLY tools you need are a 5 mm allen head wrench to remove the existing screw in the grouphead and a 7/16" wrench or small crescent wrench to install the adaptor. You might also want to use a small 6" ruler to measure/check the probe protrusion.

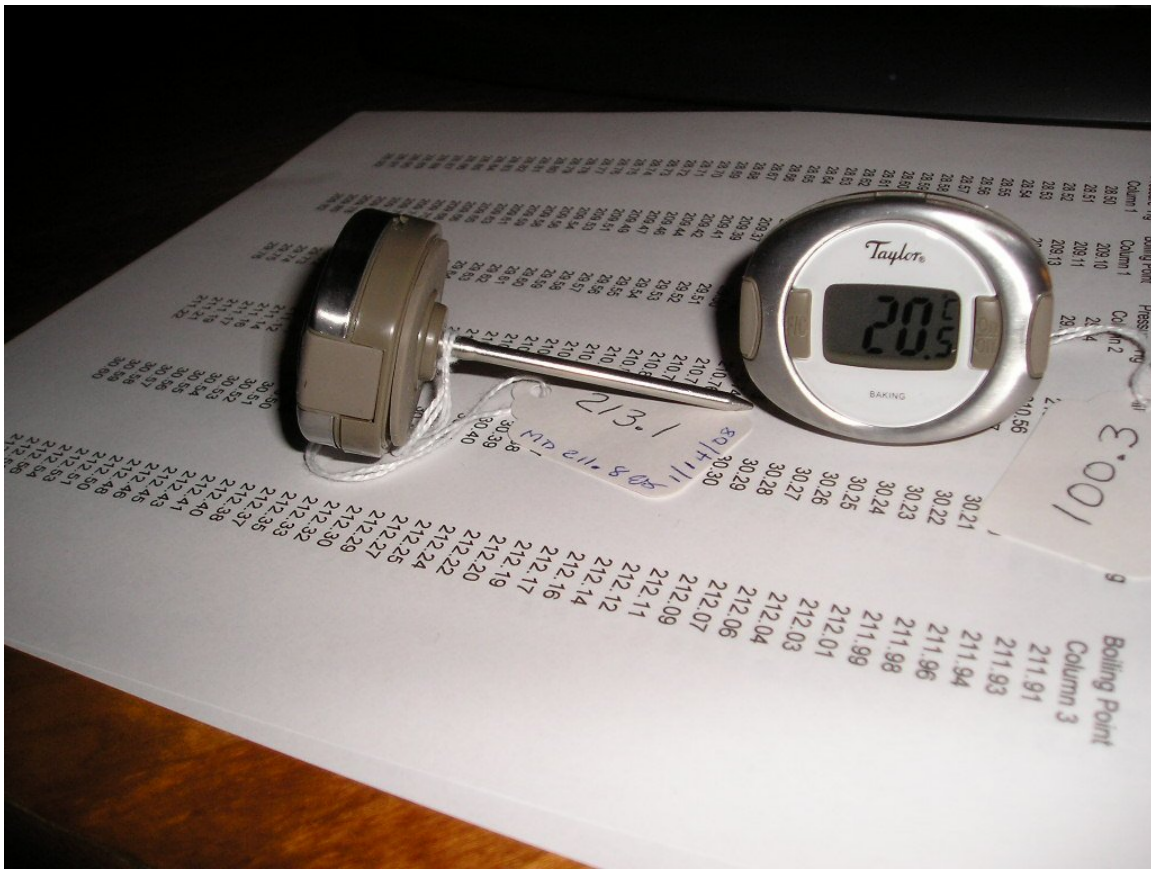
15. Are there any other uses for this device that you can think of?

When your espresso production is over for the day and your machine has been on but idle for at least one hour, do the following and record the results, along with the date.

Record the maximum pstat reading (boiler pressure) and grouphead temperature. Start the "timer" and flush till the thermometer reads temperature "A". Let the machine recover to temperature "B" (rising to, not falling to). When the digital thermometer hits temperature "B", stop the timer. Suggested vales for temperature "A" – 175 to 185
Corresponding values for temperature "B" – 190 to 200

Do this test every month and you will have a good idea as to when your machine might need some descaling (or not). As long as the pstat setting is not changed, increased recovery time is a direct indicator of scale build-up on the heat exchange surfaces.

End of FAQ – Please suggest more



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